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Animal Housing—Chimney Overview

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Animal Housing—Chimney Overview

Application: used for building ventilation air

Pros

- Effective on odor reduction, especially in areas less than 1000 feet from the building.
- Some designs may reduce dust emission.

Cons

- No reduction in emission occurs.
- Chimneys must be relatively tall to have a significant impact.
- Appearance of chimneys may make the building look "factory-like".

Description

Chimneys or stacks have been used for many years in industries concerned about the impact of emissions in a localized area. In industry, these are normally very tall structures, sometimes called "smoke stacks", which are quite effective. The reason they are effective is that normally wind speed and air turbulence increase higher in the atmosphere. This wind speed and turbulence helps to disperse the emitants rather quickly, diluting them as they travel from the source. They do not reduce emission, just dilute it. Nearer the ground, air movement can be nearly still and emitants can travel along the ground without being dispersed as much.

Two main qualities of a chimney impact effectiveness, height and air speed through the chimney. Kai et al (2003) tested three different heights of chimneys: low (2 feet above the roof); medium (10 feet above the roof); and high (20 feet above the room). They found that using the medium height chimney reduced odors, especially within 160 feet. The high chimney tended to be most effective to a distance of 500 feet but had fluctuations in concentrations that may be noticeable to neighbors. Sheridan et al (2004) tested chimneys with different upward velocities. An upward velocity provides a better means of vertically distributing the odor plume from ventilation fans. They found that an upward velocity of 1400 feet per minute (~16 mph) resulted in improved dispersal of odors within 1000 feet of the chimney. Most fans would have an exit velocity greater than this speed when operating at full speed. Fans which are mounted horizontally to remove air through the sidewall, as is common in the U.S., would have very little upward air speed.

Ventilation fans in Europe are typically mounted to exhaust air through the ceiling and out through a chimney above the roof (Figure 1) and are thought to have a good localized odor reduction. European farms are often close to neighbors and this is an important approach in avoiding nuisance odors. Notice that these fans exhaust high above the ridge of the roof. Sidewall fans have been boxed into a chimney on the Iowa State University Swine Teaching Farm (Figure 2). In this design the fans from one room are placed together on the wall and exhaust directly into the chimney. This design has a good localized effect for farm visitors, but likely could be improved by extending the chimneys above the ridge of the roof to take better advantage of wind currents. Care was taken during design to avoid creating a back pressure on the fans which would reduce output, but this design resulted in low upward velocities. One of the positive aspects of this system is that dust tends to stick to the inside of the

Figure 1. Ventilation chimney stacks on a German swine farm.

Figure 2. Chimneys designed for sidewall ventilation fans on the ISU Swine Teaching Farm.

chimney and may offer some reduction in odor transmission due to particulate matter. A drain, either to the outside or to the manure pit would be an appropriate addition so as to facilitate dust wash-down and removal. One possible downside could also be the appearance of "factory-like" stacks that could feed the negative image of "factory farming".

Effectiveness

Component	Effectiveness	Notes
NH3	0%	
H2S	0%	
Odor	75%*	Localized effect
Particulate Matter	50%*	With certain designs
Volatile Organic Compounds (VOC)	0%	
Cost	$	Materials and labor

*No data. Estimated.

Cost Considerations

Chimney systems may be installed simply by choosing European-style chimney fans with risers. These may be slightly more difficult to locate in the U.S. and may cost more than a normal wall fan. Installation may be slightly more difficult because fans penetrate the ceiling and roof structure. Constructed chimneys around sidewall fans would have the added costs of materials to form the chimney.

More Information

Pork Information Gateway

- Controlling Odors from Swine Operations. http://www.porkgateway.org/FileLibrary/PIGLibrary/How-Tos/Controlling%20Odors%20from%20Swine%20Operations%20WITH%20NEW%20NUMBER.pdf

National Pork Board

- Siting and Building Design Considerations to Reduce Odor Potential from Swine Facilities. http://www.pork.org/filelibrary/Factsheets/Environment/Siting%20Building%20Design%202.pdf
- Basic Management Practices to Mitigate and Control Odors from Swine Operations. http://www.pork.org/filelibrary/Factsheets/Environment/OdorManagement%204.pdf

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